Preface

Most of us who study rivers and streams do so for reasons both ineffable and practical. Time and rivers go one way — the water moving past one’s hip boots isn’t the same water of a moment ago. River water has its birth in the mountains and in death merges with rivers past and present to await a hydrological reincarnation. Perhaps we see in streams an image of our passage through life and so feel a kinship with running waters not possible with geological processes so slow as to seem immortal. Streams have a gravity which attracts humans. When we’re young, we need no excuses to play in the water but older folks become anglers, river runners, or stream ecologists.

The practical importance of understanding running water systems is evident in many ways. Rivers and streams serve as transportation corridors, as waste receptacles, as sources of water for drinking, manufacturing, and irrigation, and as habitat for sport and commercial fisheries. Most of these uses conflict with one another. Moreover, streams derive much of their character from their catchment basin and riparian zone so that, like dogs that reflect both the nature of their breed and the personality of their owners, streams reflect both the natural characteristics of the landscape and the local and global effects of humanity. Physicians, drawing upon centuries of basic research in human anatomy and physiology, have developed procedures for assessing health and diagnosing disease, repairing injuries and defects, and maintaining wellness. Our stewardship of running waters — protecting exemplary and fragile systems, managing multiple use conflicts, healing damaged rivers and streams — requires the same predictive understanding of structure and function.

Purpose of the course

Lectures will emphasize concepts and principles, with examples from the original literature (tables, figures etc.). Since many class members will be involved with managing Alaskan or other high latitude systems. I’ll include as much material on ecology of Alaskan rivers and streams as time permits. Lectures and mini-essays should prepare students to critically read the literature in stream ecology. As a class project, we will jointly write the third issue of a magazine devoted to streams and rivers, providing an experience in writing popular science.

Text


Lecture summaries (including copies of overhead transparencies), references cited, and an annotated further reading list will be provided as handouts. There is a $10.00 charge (payable to Beth Laursen, rm 210A, Dept. Biol. Wildl. office) to defray a portion of the photocopy costs for handouts and production costs of our magazine.

Schedule

I’ve attached two versions of the sequence of course topics: a short one page overview and a lengthier expanded outline. I will be rewriting the course materials this year and so I can’t supply a day-by-day (or even week-by-week) schedule of lecture topics. Moreover, I won’t be able to cover all of the topics listed in the expanded outline (which is really an embryonic book) but I’ll make it clear in the handouts which topics are included in lectures and exams.
Exams, Mini-essays, and Project

Lecture exams will consist of a variety of "objective" (true-false, multiple choice, matching), questions as well as short answer and data interpretation questions. There will be three (3) lecture exams as follows:

<table>
<thead>
<tr>
<th>exam #</th>
<th>points</th>
<th>date</th>
<th>covers topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75</td>
<td>16 February</td>
<td>The nature of streams and rivers + Geology, physics and chemistry: an ecological approach</td>
</tr>
<tr>
<td>2</td>
<td>150</td>
<td>5 April</td>
<td>Biology of running waters</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
<td>6 May (8:00-10:00 AM) final exam period</td>
<td>Running waters and human ecology</td>
</tr>
</tbody>
</table>

I reserve the right to change the date of an exam with at least one week's notice.

Take-home "Mini-essays"

Over the course of the semester, I will provide five take-home essay questions, each of 25 points. The lowest score will be dropped providing a total of 100 points (4 @25 each). The essays will be "open book" (you can use any resources you wish). You may work individually or "co-author" the essay (up to 3 authors allowed). Co-authors will each receive the same score. Unless your handwriting is of calligraphic quality, I'd like the "mini-essays" word-processed.

Running waters: a magazine of streams and rivers

As a class project, we will write the third issue (who knows what the future might hold) of a magazine titled Running waters: a magazine of streams and rivers. This magazine is aimed at an audience of intelligent lay readers, college students and instructors interested in freshwater ecology, and readers seriously involved in any aspect of rivers and streams (from fly fishers to river runners to professional ecologists). The level of difficulty (vocabulary, assumed background knowledge) should be about that of Natural History or Discover magazines. Each of you will contribute one submission (100 points) chosen from the following:

- summary of a citation "classic" journal article, with an assessment of the impact of the article on stream ecology
- personal experience story - if you've floated the Yukon, spent a summer counting salmon, or spent the summer as a fly-fishing guide, here's your chance to put it into an ecological perspective and tell us about it
- book review
- "how to" article (technique described with words, drawings, photos)
- theme article or essay (just about any topic is fair game: profile of a stream or river, description of an ecological process, a natural history description ~ a lotic organism, a riverine management issue)
Our publication schedule is as follows:

<table>
<thead>
<tr>
<th>date</th>
<th>submission</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 February</td>
<td>author's proposal, including type of intended submission, with title of book or article (for book review or citation classic) or topic (for &quot;how to&quot; or theme article)</td>
</tr>
<tr>
<td>8 March</td>
<td>first draft of all material</td>
</tr>
<tr>
<td>15 April</td>
<td>final draft of all material</td>
</tr>
</tbody>
</table>

I will act as editor. My editorial tasks will include consultation with authors on potential submissions and review of first drafts of your submissions. Your final submission, except for any illustrations, must be a word processor file on disk in Apple Macintosh format. Both PC's and Mac's are available in the Dept. Biology & Wildlife microcomputer labs and elsewhere on campus. I will collate all submissions into a desk-top publishing program, bind the magazine, and provide a copy to all class members. All photographs will be converted to black and white (color duplicating is still far too expensive). Please submit photographs to me with your first draft to allow time for scanning (Photo CD or other technique) to high quality digital form. Any photographs must be your own or you must have written permission from the owner. Computer-generated graphics (in Macintosh format) would be just fine. A copy of the last two year's issues are on reserve in the BioScience library.

Grading

In summary, point values and grades for the course will be distributed as follows:

<table>
<thead>
<tr>
<th>3 lecture exams</th>
<th>300 points</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 points each of 4 &quot;mini-essays&quot; (5 taken - lowest dropped)</td>
<td>100 points</td>
</tr>
<tr>
<td>magazine submission</td>
<td>100 points</td>
</tr>
<tr>
<td>total</td>
<td>500 points</td>
</tr>
</tbody>
</table>

Grades will be determined on total points at the end of the semester as follows:

A ≥ 90%  B ≥ 80%  C ≥ 70%  D ≥ 60%  F ≤ 60%

Late work policy

Dealing with late work is a difficult matter. It is unfair to allow some people to submit late work while others make the effort necessary to submit work on time. On the other hand, life is full of inconveniences (flu, kids with appendectomies, frozen houses). I've tried to find the middle way.

- A late exam will require a signed form indicating that one of life's unpredictable problems has occurred.
- Mini-essays and your various submissions for the magazine may be turned in up to one week late; again, a signed form indicating an unpredictable problem will be required. Please prepare your assignments with sufficient lead time that minor computer problems will not delay your submission.
• Documented long-term illness (or similar trauma) of you or an immediate family member will be given special consideration.

• Unexcused late exams or work will receive a “late” designation. Late designations will be used in deciding borderline grades at the end of the semester.

• I reserve the right to submit an NB ("no basis for grade" – see current UAF catalog) grade for any student who fails to submit a substantial portion of the course assignments in timely fashion.
<table>
<thead>
<tr>
<th>week of</th>
<th>topic</th>
<th>Allan readings</th>
<th>tests/due dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 22 - 26</td>
<td>Geomorphology, Hydrology</td>
<td>chap 1</td>
<td></td>
</tr>
<tr>
<td>Jan 29 - Feb 2</td>
<td>Temperature</td>
<td>chap 3.3 (pp 69 - 81)</td>
<td>authors proposal for magazine article due 2 Feb</td>
</tr>
<tr>
<td>Feb 5 - 9</td>
<td>Chemistry</td>
<td>chap 2, chap 13</td>
<td>mini-essay 1 due 9 Feb</td>
</tr>
<tr>
<td>Feb 12 - 16</td>
<td>Chemistry</td>
<td></td>
<td>Exam 1 = 16 Feb</td>
</tr>
<tr>
<td>Feb 19 - 23</td>
<td>The organisms of running waters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb 26 - March 1</td>
<td>Food webs and energetics</td>
<td>chaps 4, 5, 6, 7, 8</td>
<td>mini-essay 2 due 26 Feb</td>
</tr>
<tr>
<td>March 4 - 8</td>
<td>Food webs and energetics</td>
<td></td>
<td>draft magazine article due 8 March</td>
</tr>
<tr>
<td>March 11 - 15</td>
<td>Spring Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>March 18 - 22</td>
<td>Food webs and energetics</td>
<td></td>
<td>mini-essay 3 due 22 March</td>
</tr>
<tr>
<td>March 25 - 29</td>
<td>Patterns in space</td>
<td>chap 3.1, 3.2 (pp. 45-69)</td>
<td>(re-write day 25 March)</td>
</tr>
<tr>
<td>April 1 - 5</td>
<td>Patterns in time</td>
<td>chap 10</td>
<td>Exam 2 = 12 April</td>
</tr>
<tr>
<td>April 8 - 12</td>
<td>stream organisms as indicators</td>
<td>chap 14</td>
<td></td>
</tr>
<tr>
<td>April 15 - 19</td>
<td>fish habitat + stream rehabilitation/improvement</td>
<td>Bjornn and Reiser (1991) - on reserve</td>
<td>mini-essay 4 due 17 April</td>
</tr>
<tr>
<td>April 22 - 26 (no class 26 April = All Campus Day)</td>
<td>climate change + acid precipitation</td>
<td></td>
<td>final draft of magazine article due 22 April</td>
</tr>
<tr>
<td>April 29 - 3 May</td>
<td>forestry</td>
<td></td>
<td>mini-essay 5 due 29 April</td>
</tr>
<tr>
<td>Mon 6 May 8:00-10:00 am</td>
<td>Final exam</td>
<td></td>
<td>Exam 3</td>
</tr>
</tbody>
</table>
The nature of streams and rivers

A biography of the The Columbia River system

Land, air, and sea: the connections of running waters

The geology, physics and chemistry of running waters: an ecological perspective

Geomorphology of riverine landscapes and streams
- Drainage basin patterns
- types of patterns
- stream ordering systems
- meanders and braiding
- Evolution of rivers
- Physical habitats
- hierarchical organization
- habitat types
- substrate types

Hydrology
- Sources of water
- Discharge
- measuring and summarizing discharge
- short-term responses of drainage basins to precipitation
- yearly patterns of discharge
- differences among stream types
- regional differences
- The physics of flow
- vertical profiles of water velocity
- where water meets substrates
- Staying put: organism adaptations to life in a moving fluid

Temperature
- Temperature: a master variable
- Measuring water temperature: techniques and data reporting
- What determines water temperatures in streams?
- The ecological consequences of ice

Chemistry
- The chemical composition of fresh water
- Regional differences in water chemistry
- Nutrient and organic material spirals
- Nutrient and carbon budgets
- stream reach
- watershed

The biology of running waters

The organisms of running waters: an overview
- Microbes
- Micro- and macroinvertebrates
- Plants
- Fishes
- Birds and mammals

Food webs and energetics
- Functional groups, guilds, and food resources
- leaves, microbes, and shredders
- periphyton and grazers
- seston and filter-feeders
- benthic detritus and gatherers
- macroinvertebrate predators and prey
- Vertebrate herbivores, predators, and scavengers
- fish
- birds
- mammals
- Food chains and food webs
- Production
- primary production
- methods of measuring primary production of periphyton
- regional patterns in primary production values
- P/B ratios
- factors determining primary production
- Secondary production
- bioenergetics of individuals
- methods of measuring secondary production of benthic macroinvertebrates
- P/B ratios of macroinvertebrates
- growth and production of stream fishes
- flow of energy in stream and river food webs

Patterns in space
- Longitudinal changes along the stream-river continuum
- community composition from headwaters to mouth
- the River Continuum Concept
- Habitat biology
- periphyton
- macrophytes
- macroinvertebrates
surface substrates
substrates
water flow
hyporheic habitats
fishes
Community structure
macroinvertebrates
fishes
Latitudinal and elevational comparisons

Patterns in time
Seasonality in streams and rivers
Macroinvertebrate life histories
life history types
factors controlling growth,
development, and reproduction
Drift and recolonization
Fishes
seasonality of growth and reproduction
migration

Time and space in hand: evolution of riverine communities
Paleolimnology of riverine habitats
Biogeography
macroinvertebrates
fishes

Running waters and human ecology

Human ecology: “a river runs through it”
Floodplain agriculture and fisheries
Rivers as transportation corridors
Riverborn dieases
Rivers in religion and myth

Multiple use of running waters

Human impacts on running waters: Trouble in River City
Sewage
Dams and impoundments
Logging
Toxic chemicals
Acid precipitation
Mining
Climate change

Constructing running waters
Renovation of damaged streams
Man-made waterways
Aquaculture
Artificial streams

Epilog – trout fishing as applied ecology